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**From:** d'Almeida, Carolyn K. [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=9EC4401AFA1846DD93D52A0DDA973581-CDALMEID]  
**Sent:** 10/13/2015 10:49:07 PM  
**To:** Wayne Miller [Miller.Wayne@azdeq.gov]  
**CC:** Davis, Eva [Davis.Eva@epa.gov]  
**Subject:** FW: 2015-10-8 - WAFB – ADEQ Comments – for agency review- ST012 SEE Weekly Progress Rpts thru Sept 14 2015 - fpu16-080

Wayne

Eva sent me comments on your draft letter; see below:

Carolyn

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**From:** Davis, Eva  
**Sent:** Tuesday, October 13, 2015 2:52 PM  
**To:** d'Almeida, Carolyn K. <dAlmeida.Carolyn@epa.gov>  
**Subject:** RE: 2015-10-8 - WAFB – ADEQ Comments – for agency review- ST012 SEE Weekly Progress Rpts thru Sept 14 2015 - fpu16-080

Carolyn –

First I will respond to the Specific Comments on the TerraTherm progress report, then on ADEQ's general comments, from the draft letter.

Section 3 comment – We discussed with TerraTherm during the meeting in SF that the PID readings do not show an obvious effect of pressure cycling, however, if you observe slide 35 from the September 15, 2015 meeting, you can see that when the PID data are plotted on a linear scale, that some peaks in mass removal are observed during pressure cycling. Also, slide 37 shows that benzene concentrations in the vapor phase peaked during depressurization events.

The decreasing benzene and increasing naphthalene concentrations observed over time in the figure provided in Section 3 are exactly what you should expect.

Section 4 comment – the figure provided in this section is interesting. Remember that steam injection was not initiated in the entire site at the same time, thus breakthrough did not occur in all MPE wells at about the same time, which is why the recovery rates may not be expected to decrease after the initiation of pressure cycling, which was started when breakthrough was achieved at some of the first LSZ wells to see breakthrough.

The peak extraction rate will not be used to determine when to transition to EBR. Slide 19 from the Sept 15 meeting correctly states that diminishing mass removal rates will be a consideration, but as per the discussion we had during review of the work plan, we will mainly be using current contaminant extraction rates and groundwater concentrations to determine when to transition to EBR.

Section 8 – Boring logs for the perimeter steam injection wells in the CZ did not show contamination in the CZ, thus the temperature increases in the CZ at TMP-11 and TMP-6 do not indicate that NAPL is adversely migrating to the east, and possibly under Sossaman Road in the CZ.

I disagree that TMP-13 appears to be compromised above a depth of 205 ft. The problems that have occurred at other TMPs with joints failing have allowed groundwater into the TMP, which causes the lower TMPs to indicate the temperature of the water in the tube rather than the formation temperature. This failure mechanism would not allow the top portion of the TMP to be compromised while the bottom part continues to provide reliable formation

temperatures. While the relatively uniform profile is inconsistent with other locations, it is possible that the lower permeability soils that prevent upward steam migration in other areas are not present here.

We have discussed at the past two meetings that the TMP-12 area was heating slowly in the UWBZ and CZ. This is due to the fact that the wells on either side of the TMP-12 (UWBZ-20 and UWBZ-24) showed significant contamination, and thus were used as extraction wells initially. The plan for this area was that once concentrations in these wells was reduced, they would be used for steam injection. According to slide 22 from Sept 15, UWBZ-20 has been converted to a steam injection well, and steam injection was initiated into this well on August 26. I would assume that if this is not adequate to heat the area, UWBZ-24 will also be converted to a steam injection well.

It is true that hot water has reached the TMP-2 area. Please see slide 64 from Sept 15. It is proposed that LSZ-14 and LSZ-29 will be used as extraction wells for EBR, while injection will occur at W-36, W-34, and in two new wells, EBR-12 and EBR-13. That should provide good coverage to the area in question. My understanding is that soil cores will be obtained during the installation of these new EBR wells (although I would like to see this confirmed in a work plan). If NAPL were to be detected in these wells, the necessity of stepping out for additional injection and/or extraction wells should be discussed with the group.

Likewise it is true that steam temperature were achieved in the LSZ at TMP-10 which is just outside of the treatment zone. Slide 64 shows that LSZ-12 and LSZ-35 are proposed now as extraction wells for EBR, W-37 is proposed as an injection location, along with new wells EBR-14, EBR-15, EBR-16, and EBR-17. Again, I assume that the new wells will be characterized as they are installed, and that if they show contamination, step out wells will likely be required. I would emphasize that these well locations have been proposed at this point, but the agencies have not yet commented on this proposal. I would advocate some changes to the plans they presented, but I have not seen the draft work plan yet.

Section 15 comments – I disagree that Figures 7 & 8 show that limited heat is lost above the CZ and below the LSZ. The CZ is defined as starting at 145 ft bgs, and the temperatures recorded at 140 ft bgs in the CZ treatment area range from 80 – 100C, and other thermocouples at this depth which are outside of the CZ treatment area also show significant temperature increases. The LSZ is defined as extending to a depth of 235 ft bgs, and all TMPs within the LSZ treatment area show elevated temperatures to depths of 242 feet. Figure 13 also shows that at the MPE wells, elevated temperatures extend below 240 ft bgs. These heat losses are to be expected. Heat losses are also expected horizontally, first due to radial steam flow at perimeter steam injection wells, and then due to heat conduction horizontally from the steam front. This will occur even if the net groundwater flow is toward the treatment area.

TerraTherm's model is proprietary, and in Danish, and they should not be expected to provide it to ADEQ. The model has been used successfully to design a number of other steam injection projects. But realistically, even if there were problems with the model, what is to be gained by providing the details of it to ADEQ at this point in time? ADEQ accepted the design, we are almost a year into the implementation of the steam injection and nearing completion - what would ADEQ propose to do with this information?

Figure 20 shows an estimated 30% of the energy is lost. Currently manual temperature measurements are made weekly at 10 monitoring wells surrounding the site, and continuous temperature measurements are made at 6 other wells. Only one well, W-36, the closest perimeter well to the CZ and UWBZ treatment area, shows a significant temperature increase. This is not unexpected considering the distance from the treatment zone to the monitoring well. This indicates that there is no widespread horizontal energy loss from the site. While channeling cannot be ruled out, it should be pointed out that things like trenches for buried lines – which might be expected to be the most likely channels for taking steam from the site - do not exist in the treatment zone, as the treatment zone is well below trenching depths. If natural channels occur, the heat loss to either side of, as well as above and below the channel, will limit the steam 'excursion'. Since steam is only injected at the perimeter in clean wells, the possibility of it taking NAPL with it is very limited.

General Comment 1 – Monthly groundwater samples have been taken from wells surrounding the treatment area. The only wells that were not previously significantly contaminated that are now showing significant contamination are W-36 (the same well that has shown a temperature increase) and W-34. Note that NAPL has not been detected in this well,

but benzene concentrations have increased and have been as high as 7400 ug/l. The other sentinel wells have not been effected. Note that according to slide 64, both of these wells are proposed to be injection wells for EBR.

General Comment 2 – As mentioned previously, my understanding is that additional characterization will be completed as the EBR wells are installed.

General Comment 3 – Slide 65 states that drilling procurement is to begin this month, but I think that is getting a little ahead of things, as we haven't seen the draft work plan yet. In any event, it does appear that EBR will proceed as quickly as possible, according to the information provided during the Sept meeting.

Eva

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**From:** d'Almeida, Carolyn K.

**Sent:** Thursday, October 08, 2015 4:23 PM

**To:** Davis, Eva

**Subject:** FW: 2015-10-8 - WAFB – ADEQ Comments – for agency review- ST012 SEE Weekly Progress Rpts thru Sept 14 2015 - fpu16-080

Eva

See attachment and Wayne's note below

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**From:** Wayne Miller [<mailto:Miller.Wayne@azdeq.gov>]

**Sent:** Thursday, October 08, 2015 2:20 PM

**To:** d'Almeida, Carolyn K. <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; steve <[steve@uxopro.com](mailto:steve@uxopro.com)>

**Subject:** 2015-10-8 - WAFB – ADEQ Comments – for agency review- ST012 SEE Weekly Progress Rpts thru Sept 14 2015 - fpu16-080

Carolyn – Can you please look over the attached and let me know if content will create extreme dissension among regulatory agencies?

Steve – Can you please have Bo and yourself verify that the intent has been captured?

Thank you.

Maybe Friday, but likely Tuesday for this to be sent.

Have a great Columbus or Indigenous American or whatever day they label Monday, October 12, 2015 in your area.

Wayne Miller

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